

Analgesia in pet rabbits: a survey study on how pain is assessed and ameliorated by veterinary surgeons

Livia Benato ,¹ Joanna C Murrell ,² Emily Jayne Blackwell,¹ Richard Saunders,³ Nicola Rooney¹

Abstract

Background In the last 20 years, two studies on the veterinary use of perioperative analgesia in small mammals reported a limited use of analgesics in rabbits but suggested an increasing use over the years. The aim of this study was to better understand how pain is treated and ameliorated in rabbits while under veterinary care.

Methods An online survey of 60 questions was developed and advertised at national and international veterinary conferences, in veterinary publications and on social media.

Results In total 94.3 per cent of the respondents routinely administered nonsteroidal anti-inflammatory drugs (NSAIDs) to rabbits undergoing surgical procedures such as neutering, 71.4 per cent administered an opioid and 70.3 per cent routinely administered multimodal analgesia, although dosages do not always match current consensus opinion. Buprenorphine and meloxicam were the most common analgesic drugs prescribed by the respondents. The dosage of meloxicam administered both parenterally and orally varied widely.

Conclusion Rabbit analgesia has improved over recent years similarly to the trend seen in other companion animals. However, overall it seems that pain assessment is still limited in rabbits. The lack of multimodal composite pain scales specific for rabbits makes this task even more challenging.

Introduction

Rabbits are popular pets and they are commonly treated by veterinarians for medical and surgical procedures,¹ and perioperative analgesia is an important aspect of the rabbit's care. It is important to minimise pain in order to reduce perioperative complications^{2,3} and allow the animal to recovery rapidly with a prompt return to normal behaviour.

In 1999, a survey on the veterinary use of perioperative analgesia in small mammals such as rabbits, guinea pigs and ferrets showed limited use of analgesics in these species:⁴ despite 93 per cent of the respondents performing surgical procedures on rabbits, only 22 per cent administered analgesia routinely⁴. This study reported that approximately 75

per cent of respondents considered their knowledge of pain and analgesia inadequate. This was supported by another study on the attitude of veterinary professional towards pain in rabbits.⁵ A low caseload, under-recognised pain in the rabbit patient and unclear protocols on the most effective pain management were suggested as explanations for the low confidence and infrequent administration of analgesia in this species.^{4,6} Another study also confirmed little use of analgesia in laboratories with only 16 per cent of laboratory rabbits receiving some form of analgesia during experimental surgical procedures between the years 1995 and 1997.⁵ However, the same study also suggested the use of analgesia was increasing over the years, with 50 per cent of the animals receiving analgesia in the years between 2005 and 2007.⁵ No follow-up studies have been conducted since 2007 and it is unknown if analgesia use in rabbits has further increased in the intervening years.

No validated composite pain scales and only one validated grimace scale⁷ is currently available to facilitate pain quantification in this species. Moreover, rabbits are prey species and they are predisposed to masking signs of pain, making it difficult to identify the level of pain and discomfort, hence making assessment challenging.⁸

Veterinary Record (2020)

doi: 10.1136/vr.105071

¹Animal Welfare and Behaviour, School of Veterinary Sciences, University of Bristol, Langford, UK

²School of Veterinary Sciences, University of Bristol, Langford, UK

³Rabbit Welfare Association and Fund, Enigma House, Culmhead Business Centre, Taunton, UK

E-mail for correspondence: Dr Livia Benato; livia.benato@bristol.ac.uk

Provenance and peer review Not commissioned; externally peer reviewed.

Received June 23, 2018

Revised January 29, 2020

Accepted March 12, 2020

It is also considered difficult to choose an adequate analgesic protocol for rabbits as little evidence-based information is available. It is the current consensus that multimodal analgesia is best practice. However, the optimal dose, timing, duration and drugs combinations remains to be established in rabbits with only few studies on clinical efficacy.^{9 10}

We therefore carried out a questionnaire survey of veterinary surgeons aimed to answer the following research questions in regard of Analgesia (1), Pain assessment (2) and Pain amelioration (3):

1. Do veterinary surgeons prescribe analgesia to rabbits undergoing a surgical procedure? How painful do veterinary surgeons believe to be the most common surgical procedures performed in rabbits in a veterinary clinic?
2. Are veterinary surgeons confident in recognising pain in rabbits? Does this vary with the number of animals they treat? What pain assessment tools do they use?
3. Which analgesic drugs are commonly prescribed during the perioperative time? Which analgesic drugs are most commonly prescribed at discharge?

Materials and methods

An online survey of 60 questions was developed using Google forms (Google LLC) and presented as online supplementary appendix 1. The survey was composed of three sections: 'Demographics', 'Pain assessment' and 'Pain amelioration'. In the 'Demographics' part, the respondents were asked about their age, sex, year of graduation, postgraduate training, the country where they practise, the veterinary clinic where they work, the number of rabbits they treat monthly and common surgical procedures performed at the clinic. They were also asked to express an opinion regarding their level of knowledge in treating rabbits. In the part on 'Pain assessment', the respondents were asked what they thought were common causes of pain in rabbits and to pain score common surgical procedures in rabbits using a 0–7 scale where zero was 'no pain at all' and 7 'the worst imaginable pain'. Details on pain assessment such as what the respondent considered the most common clinical signs of pain in rabbits, if pain assessment tools were used at the clinic, when pain assessment would be carried out were also asked. They were also asked how confident they felt (on a 3-point-scale) in their ability to recognise pain in rabbit patients. The final part on 'Pain amelioration' sought information regarding drugs and protocols commonly prescribed during the perioperative period in their practice. What analgesic protocol, if any, they would prescribe at discharge after surgery and what factors would influence their choice of a specific analgesic drug were also among the questions. The survey was advertised at national and international veterinary conferences, in veterinary publications and on social media such as Facebook. To improve response rates, no geographical limitations were considered. The data were saved on Excel 2016 spread sheets and analysed using an IBM SPSS Statistics 23 software.

Statistical analysis

Results of descriptive statistical analysis are reported as per cent, median, IQR and range. Data were assessed for normality by visual examination of histograms normal probability plots (P-P plot). Non-parametric tests were used to compare pain assessment and amelioration protocols to respondent's demographics (sex, age, no. of rabbits seen and qualification) using Spearman's rank correlation, Kruskal-Wallis, and Mann-Whitney U tests. The coefficient of determination (r^2) which value describes the percentage of variability accounted for by the relationship was also reported. Significance was considered $P < 0.05$.

Results

Demographics

A total of 360 questionnaires were returned. Ten questionnaires were removed from the analysis either because they were not from veterinary surgeons ($n=2$) or they were entered more than once from the same person ($n=8$). Therefore, a total of 350 questionnaires were retained for analysis of which 88 per cent were from the UK (74 per cent England, 9 per cent Scotland, 4 per cent Wales, 0 per cent North Ireland), 8 per cent were from the rest of Europe and 5 per cent from outside Europe. Demographic details of the respondents are given in [table 1](#).

At the time of the questionnaire, the majority of the respondents (47 per cent) worked in a veterinary clinic that treated 'Small animal and Exotics' and the majority of respondents (67 per cent; 95 per cent CI: 62.3 per cent to 72.3 per cent) treated 1–10 rabbits per month including an average of (median; range, 25th and 75th percentiles) 1 (0–35; 0 and 2) ovariohysterectomies (OVH) and 1 (0–35; 1 and 3) castrations per month. The most commonly reported procedures in the last six months were castration and coronal reduction of cheek teeth ([table 2](#)).

When asked how they would describe their knowledge or experience in treating rabbits, the majority of respondents reported that it was either 'Good' (42 per cent; 95 per cent CI: 36.9 per cent to 47.4 per cent) or 'Adequate' (32 per cent; 95 per cent CI: 26.9 per cent to 36.6 per cent) with only 6 per cent (95 per cent CI: 4 per cent to 8.9 per cent) reporting it was 'Excellent'. The rest of the respondents reported that it was 'Fair' (15 per cent; 95 per cent CI: 11.4 per cent to 19.1 per cent), 'Poor' (4 per cent; 95 per cent CI: 2 per cent to 5.7 per cent) or they were unsure (1 per cent; 95 per cent CI: 0 per cent to 1.4 per cent).

Pain assessment

When asked to assign a score from 1 to 7 (1=Not painful at all; 7=Extremely painful) for the severity of pain caused by the most common surgical procedures performed in rabbits, coronal reduction of the cheek teeth was considered the least painful procedure

Table 1 Demographic details of the respondents

Demographic	Percentage
Sex	
Male	22.4
Female	77.6
Age group	
21–29	28.6
30–39	33.4
40–49	22.9
50+	15.1
Postgraduation degree:	
None	67.1
Working towards a Certificate	18.6
Certificate	14.3
Diploma	6.3
CPD hours on Rabbit Medicine and Surgery in the last 12 months	
0	31.1
1–3	29.6
4+	39.3
Type of veterinary clinic	
Small animal and exotics	47.1
Mixed and exotics	3.1
Exotics only	0.9
Small animal clinic	36.9
Mixed practice	10.9
Others	0.9
Type of veterinary clinic	
First opinion	76
First opinion and referral	17.4
Others (ECC service, Referral only, Charities)	6.6
Rabbits (no.) treated per month	
0	2.3
1–10	67.4
11–20	16
21–30	7.7
31+	6.6

CPD, continuing professional development; ECC, emergency and critical care.

while orthopaedic procedures were considered the most painful ones. Castration and lumpectomy were considered less painful than procedures such as OVH and cystotomy (figure 1). Pain score was very weakly correlated to respondent's age group ($r_s=0.12$; $r^2=0.014$; $P=0.025$) with older respondents generally giving higher pain scores.

The majority of the respondents reported they were 'Fairly Confident' in recognising signs of pain in rabbits (64 per cent; 95 per cent CI: 59.4 to 69.1). The rest of

Table 2 Percentage of the respondents performing common surgical procedures in rabbits in the last six months

Surgical procedures reported	Percentage
Castration	85.1
Coronal reduction of cheek teeth	81.1
Ovariohysterectomy	76.0
Surgical removal of abscesses	42.3
Incisor removal	35.7
Lumpectomy	24.6
Exploratory laparotomy	17.4
Cystotomy	13.1
Orthopaedic surgery	4.6

the respondents reported they were 'Very Confident' (6 per cent; 95 per cent CI: 4.3 per cent to 9.7 per cent) or 'Not Very Confident' (29 per cent; 95 per cent CI: 24.3 per cent to 33.7 per cent). Respondents' confidence in recognising signs of pain in rabbits was very weakly correlated to the number of rabbits treated per month ($r_s=0.23$; $r^2=0.052$; $P=0.0001$) and to the frequency of using a pain scale ($r_s=0.118$; $r^2=0.013$; $P=0.027$). The majority of the respondents reported that they did not use a pain scale (77 per cent; 95 per cent CI: 72.8 per cent to 81.7 per cent) but often relied on physiological and behavioural indicators (39 per cent; 95 per cent CI: 34 per cent to 43.4 per cent) with 'Decrease food intake', 'Abnormal posturing' and 'Grinding teeth' being considered the most reliable ones (table 3). A pain scale was used 'All the time' or 'Sometimes' by only 10 per cent (95 per cent CI: 7.2 per cent to 13.8 per cent) and 12 per cent (95 per cent CI: 9 per cent to 16 per cent) of respondents respectively. Overall, 12 per cent (95 per cent CI: 8.6 to 16) of the respondents used the Rabbit Grimace Scale and 6 per cent (95 per cent CI: 1.5 to 10.6) simple descriptive scales. Respondents with a Postgraduate Certificate ($P=0.009$) were more likely to use a pain scale.

Analgesia

Overall 94 per cent (95 per cent CI: 91.4 per cent to 96.6 per cent) of respondents routinely administered nonsteroidal anti-inflammatory drugs (NSAIDs) for rabbits undergoing surgical procedures such as neutering, 71 per cent (95 per cent CI: 66.6 per cent to 76.3 per cent) administered opioids and 70 per cent (95 per cent CI: 65.7 per cent to 74.9 per cent) used a multimodal analgesia regimen (combination of NSAIDs and opioids) (table 4). The use of multimodal analgesia was very weakly negatively correlated to age of respondents ($r_s=-0.107$; $r^2=0.011$; $P=0.04$); younger respondents used it more often.

Analgesia was prescribed at discharge by 95 per cent of the respondents performing orthopaedic surgery, by 86 per cent after cystotomy and exploratory laparotomy, 82 per cent after incisor removal, 79 per cent after OVH and by fewer respondents for abscess removal (76 per cent), lumpectomy (74 per cent) castration (64 per cent) and coronal reduction (52 per cent). The majority of the respondents prescribed analgesia at discharge for two to four days for those procedures considered less painful such as castration and OVH and between four and seven days for those more painful such as orthopaedic surgeries (table 5). Comparing the two elective surgeries (OVH and castration), the length of analgesic treatment course prescribed by the veterinary surgeon at discharge was very weakly correlated to the pain score they gave for the OVH ($r_s=0.113$; $r^2=0.012$; $P=0.037$) but not for castration ($P=0.21$).

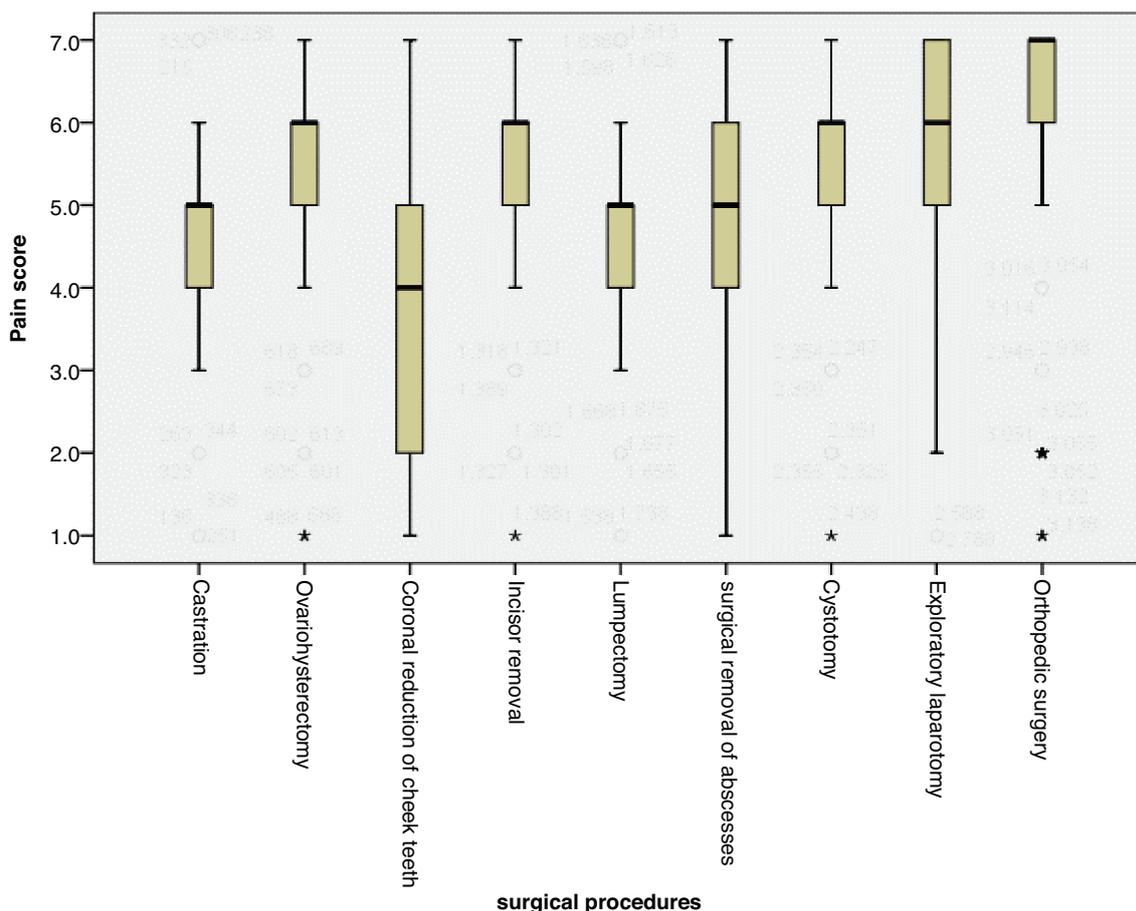


Figure 1 Box plot of median pain score assigned by respondents to common surgical procedures in rabbits. Pain score from 1 to 7 (1=Not painful at all; 7=Extremely painful) The box represents the middle scores of the group. The line that divides the box into two parts represent the mid-point of the data. The upper and lower whiskers represent the greatest and least scores. *Represents outsiders.

Buprenorphine was the most common opioid prescribed by the respondents at discharge (table 5). Among the NSAIDs, meloxicam was the most commonly used analgesic treatment. The dosage of meloxicam reported by the respondents varied

widely with the majority of the respondents reported administering meloxicam at a dosage of 0.6 mg/kg (30 per cent oral route; 36 per cent parenteral route) (table 6). No significant correlation was found between dosages of parenteral and oral meloxicam prescribed

Parameters	Frequency (n)	First (per cent)	Second (per cent)	Third (per cent)
Decreased food intake	223	33	19.5	11.5
Abnormal posturing	153	17.2	13.5	13.2
Grinding teeth	145	13.2	16	12.3
Reluctance to move	136	13.5	12.6	12.9
Closed or semiclosed eyes	76	6	6.3	9.5
Decreased faecal output	56	1.7	7.4	6.9
Increased heart rate	49	2.6	5.2	6.3
Hunched back	39	0.6	4.3	6.3
Increased respiratory rate	36	2.6	3.2	4.6
Holding the ears flat against the head	33	2	2.3	5.2
Hiding behaviour	27	1.7	2.6	3.4
Loss of bodyweight	24	1.1	3.4	2.3
Aggression towards handlers	9	–	0.9	1.7
Drinking more	4	–	0.6	0.6
Increased blood pressure	2	0.3	–	0.3
Increased body temperature	2	–	–	0.6
Thumping the hind feet	1	–	0.3	–
Running away when approached	1	–	–	0.3
Others*	31	4.6	2	2.3
Total		100	100	100

*Response to analgesia, abnormal behaviour, self-mutilation, vocalisation, twitching, shuffling, loss of nose twitching.

Table 4 Most commonly analgesic drugs prescribed by the respondents when treating rabbits (per cent=percentage of respondents reported routinely prescribing a drug*)

NSAIDs		Opioids		Others	
Drug	Per cent	Drug	Per cent	Drug	Per cent
Meloxicam	76.9	Buprenorphine	46.3	Ketamine	34.6
Carprofen	2.3	Butorphanol	10.6	Medetomidine	30
Ketaprofen	0.6	Methadone	1.4	EMLA cream	24
Flunixin meglumine	0.3	Fentanyl	0.9	Tramadol	1.7
		Morphine	0.3	Gabapentin	0.9
				Amantadine	0.3
				Others (Xylazine, dexmedetomidine, tiletamine-zolazepam)	2

*The per cent of respondents not using drugs have not been reported.
NSAID, nonsteroidal anti-inflammatory drugs.

by the respondents and their age (P=0.1 and P=0.6 respectively) or the number of rabbits seen per month (P=0.41 and 0.39 respectively).

When asked about the most important factors in choosing an analgesic drug to use in rabbits, analgesic efficacy and reported safety were considered the most important ones while licensing of the product or policy of the veterinary clinic were not considered important factors (figure 2).

Discussion

Do veterinary surgeons prescribe analgesia to rabbits undergoing a surgical procedure? How painful do veterinary surgeons consider the most common surgical procedures performed in rabbits in a veterinary clinic?

In this study, it was found that 94 per cent of the respondents prescribed analgesia to rabbits during routine surgical procedures. The current finding suggests an increase compared with previous studies^{4,6} and mirrors the changes seen in the last 20 years in the prescription of analgesia in small animals. Hunt *et al*¹¹ reported that approximately 98 per cent of veterinary

surgeons prescribe perioperative analgesia in cats and dogs for routine surgical procedures. Hunt *et al*¹¹ discussed the possibility that the increase in percentage of veterinary surgeons prescribing analgesia was due to an increased availability of licensed drugs and an increase in owner expectations. In rabbits, the number of licensed products is currently still very limited compared with those available for cats and dogs. However, this did not seem to be a limiting factor during this study as the majority of the respondents considered licencing to be 'Not so important' when prescribing analgesia in rabbits. However, rabbit owner's expectations have changed over the years. In 2011, 56 per cent of the UK rabbit population was registered with a vet and 46 per cent had a first course of vaccination and 37 per cent had been neutered.¹² This has improved over the years and in 2017, 68 per cent of the rabbit population was registered with a vet, 56 per cent had been neutered and 50 per cent had the first course of vaccination.¹ Although these figures still lag behind data in cats and dogs (78 per cent and 92 per cent, respectively, registered with a vet), they show a greater awareness of

Table 5 'At discharge, what ORAL analgesic drug(s) would you usually prescribe for the following surgical procedures?' and 'Following the previous question, please indicate the ORAL analgesic treatment course that you prescribe for the following surgical procedures': N/n, Bup, Car, Mel, Tra

Surgical procedures	N/n	Oral analgesic drugs given						Treatment course in days			
		Mel	Mel and Tra	Bup	Others						
OVH	262/333	Mel	Mel and Tra	Bup	Others			1	2-4	5-7	7+
Per cent		87.1	1.1	0.3	1.1			0.6	47.4	40.6	0.6
Castration	212/336	Mel	Car	Others				1	2-4	5-7	7+
Per cent		84.6	0.6	0.9				5.1	57.4	21.4	0.3
Coronal reduction of cheek teeth	172/330	Mel	Mel and Tra	Bup	Car	Tra	Others	1	2-4	5-7	7+
Per cent		85.1	1.1	0.6	0.3	0.3	0.3	7.4	47.1	27.4	2.9
Surgical removal of abscess	251/330	Mel	Mel and Tra	Bup	Car	Tra	Others	1	2-4	5-7	7+
Per cent		86.6	3.4	0.9	0.6	0.3	0.9	0.3	40	41.1	10.3
Incisors removal	252/304	Mel	Mel and Tra	Car	Tra	Others		1	2-4	5-7	7+
Per cent		80	5.4	0.3	0.3	0.9		0.6	31.4	46.9	5.7
Lumpectomy	239/325	Mel	Mel and Tra	Bup	Car	Tra	Others	1	2-4	5-7	7+
Per cent		87.4	0.6	0.6	0.6	0.3	0.6	1.1	48.9	38.6	1.1
Cystotomy	245/285	Mel	Mel and Tra	Bup	Car	Tra	Others	1	2-4	5-7	7+
Per cent		74.3	4	2.3	0.3	0.3	1.7	0.3	26	47.1	7.1
Exploratory laparotomy	251/292	Mel	Mel and Tra	Bup	Car	Others		1	2-4	5-7	7+
Per cent		73.4	6.3	2.9	0.6	1.4		0.3	27.7	46.3	8.6
Orthopaedic surgery	224/235	Mel	Mel and Tra	Bup	Tra	Car	Others	1	2-4	5-7	7+
Per cent		53.1	10.3	2.6	0.6	0.3	3.1	7.4	25.1	34.3	32.3

Bup, Buprenorphine oral trans-mucosal route; Car, Carprofen; Mel, Meloxicam; N/n, N respondents prescribing analgesia/n of respondent performing the procedure; OVH, ovariohysterectomy; Tra, Tramadol.

Table 6 'If you use meloxicam in rabbits undergoing routine surgical procedures (surgical treatment of abscesses, lumpectomy, castration and ovariohysterectomy), what dosage do you routinely administer for both the parenteral and oral route?'

Parenteral route		Oral route	
Dosage (mg/kg)	Percentage	Dosage (mg/kg)	Percentage
0.6	36.0	0.6 SID	29.8
0.3	20.9	0.3 SID	18.9
0.2	12.9	0.3 BID	11.7
1	10.9	0.6 BID	10.9
0.5	8.9	0.2 SID	7.2
0.7	0.3	0.2 BID	5.4
2	0.3	1 SID	5.2
0.1	0.3	1 BID	3.2
		0.1 SID	3.2
		0.1 BID	2.0

BID, two times a day; SID, once a day.

the rabbit owners about the general veterinary needs of their pets.

When the respondents were asked to pain score common surgical procedures, castration was considered less painful than OVH, and orthopaedic surgeries were considered to be the most painful. These findings agree with previous studies both in laboratory rabbits¹³ and in companion animals^{4,5} where orthopaedic surgeries were scored as the most painful, followed by OVH and castration reflecting the differing complexities of the surgical approaches. In this study, statistical differences

in pain scoring were found between respondent's age groups with the older respondents generally giving an overall higher pain scores than younger respondents. Previous studies found either no difference with age^{4,11} or younger veterinary surgeons giving higher pain scores than older veterinary surgeons.^{5,14} This difference could be due to the fact that, over the years, the concept of pain has been researched more and younger generations of veterinary surgeons have more available up-to-date information regarding pain and its treatment and hence see current procedures as less painful.

Are veterinary surgeons confident in recognising pain in rabbits? Does this vary with the number of animals they treat? What pain assessment tools do they use?

In this study, 29 per cent of the respondents were 'Not very confident' in recognising pain in rabbits while the majority of the veterinary surgeons (64 per cent) were 'Fairly confident'. Based on these findings, the confidence of veterinary surgeons in recognising pain in rabbits appears overall to have improved over the last 20 years when previously it was considered inadequate by the majority of the respondents.^{4,5} These results are similar to those reported in a recent survey on cats and dogs, where approximately three quarters (77 per cent in cats; 78 per cent in dogs) of the respondents felt their knowledge in recognising pain was sufficient.¹⁴

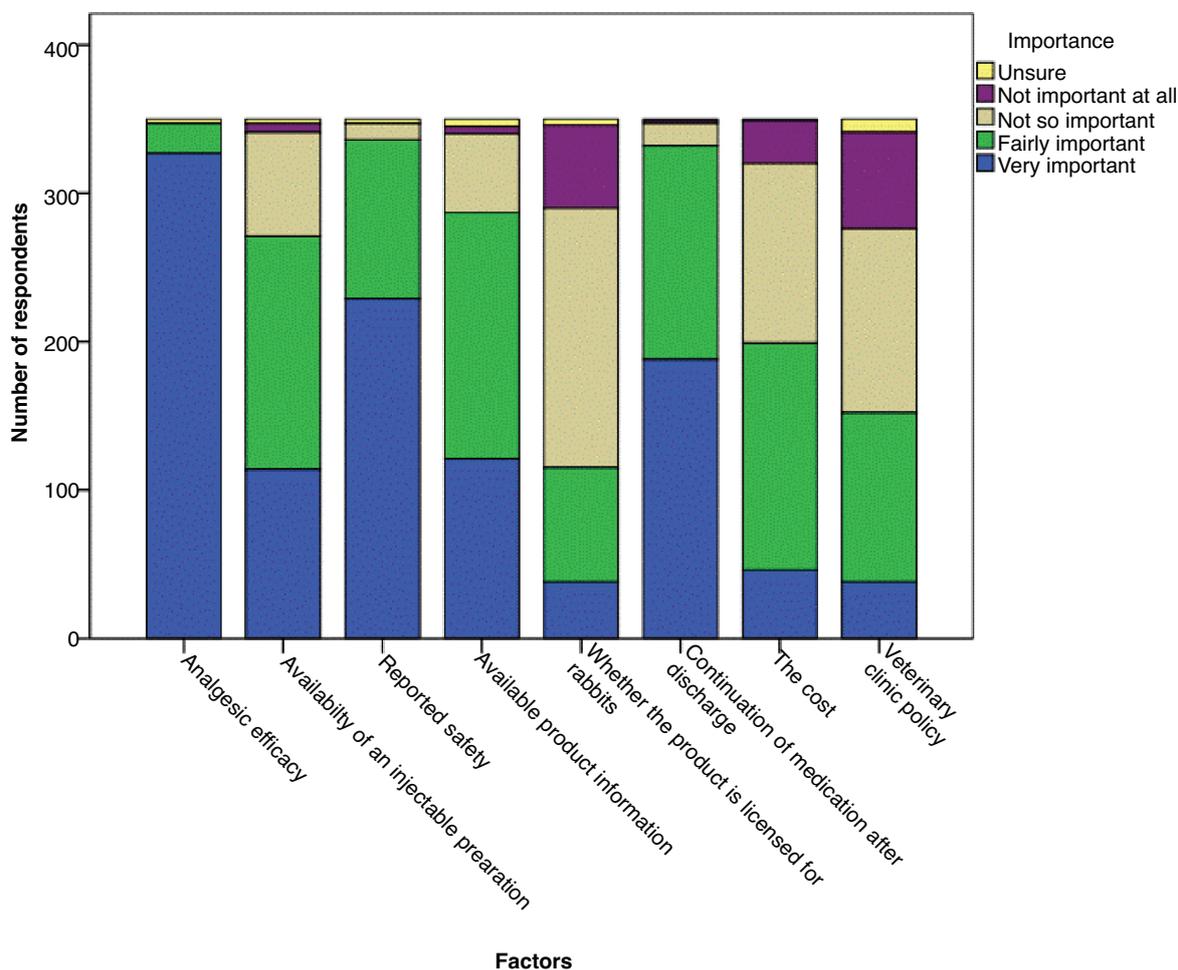


Figure 2 'When considering what analgesic drug to use on rabbits, how important are the following factors?'

As confidence in recognising pain was correlated to the number of animals treated, it may be that knowledge and confidence can be gained from experience while treating rabbits. This was also recognised in a survey on pain attitudes among New Zealand veterinary surgeons where a low rabbit caseload was associated with inadequate knowledge in recognising and treating pain.⁵

In this study, confidence in recognising pain in rabbits was also correlated to more frequent use of a pain scale. The use of a pain scale provides a more objective evaluation of the patient when pain control has to be achieved. This is more likely to strengthen the confidence of the veterinary surgeon when a clear and objective evidence of pain relief is seen. However, only a small percentage (10–12 per cent) of the respondents reported using one. Respondents with a Postgraduate certificate were more likely to use a pain scale. Similarly, in cats and dogs, only 17–20 per cent of the respondents used a formal pain assessment tool^{11 15} with members of the Association of Veterinary Anaesthetists (AVA) being more likely to use one.¹¹ In this study, the majority of the respondents relied on physiological and behavioural indicators of pain, most commonly ‘Decrease food intake’, ‘Abnormal posturing’ and ‘Grinding teeth’. This may be due to the fact that there is more research evidence on potential behavioural indicators of pain in rabbits with some studies focusing specifically on the postoperative time and that physiological parameters such as heart rate and body temperature are routinely taken during hospitalisation.^{16–18} While the general consensus is that physiological indicators are less reliable as they can also be affected by stress and infection, changes in the animal’s behaviour are still widely used as a reliable and non-invasive method of pain assessment.¹⁹

Which analgesic drugs are commonly prescribed during the perioperative time? Which analgesic drugs are commonly prescribed at discharge?

In this study, meloxicam was the most commonly prescribed NSAID and buprenorphine the most commonly prescribed opioid with 71 per cent of the respondents routinely prescribing multimodal analgesia during common surgical procedures. This suggests a great improvement over the years as no previous surveys have reported the use of multimodal analgesia in rabbits. One survey study on the use of analgesia on laboratory animals reported no use of multimodal analgesia.⁶ Similarly, 20 years ago few respondents prescribed multimodal analgesia in dogs and cats, though use varied with surgical procedure.^{4 20} Today multimodal analgesia is commonly prescribed in small animals by the majority of veterinary surgeons (56–75 per cent).^{11 15}

In this study, the majority of the respondents (29 per cent oral route; 36 per cent parenteral route) reported

administering meloxicam at a dosage of 0.6 mg/kg. Many studies have investigated the efficacy of the different doses of meloxicam in rabbits. However, some of these are published in the North America literature and may be less available to the European veterinary community. A pharmacokinetic study on 10 female NZW rabbits reported that rabbits could be treated safely with meloxicam at a dose of either 0.3 mg/kg or 1.5 mg/kg given orally once a day for five days.²¹ However, the study also suggested that a dosage higher than 0.3 mg/kg is required to achieve analgesic effects.²¹ These results were later confirmed and the dosage of 1 mg/kg once a day given orally was found to be considered clinically effective and to be well-tolerated for up to 29 days, with no obvious side effects detected.^{22 23} In the current study, only 11 per cent of the participants administered meloxicam at a dosage of 1 mg/kg (either subcutaneously or orally). This suggests that many veterinary surgeons still prescribe subtherapeutic doses, and further education and research should be strongly advocated on this topic to relieve pain and hence improve animal welfare.

Interestingly, in our study, analgesia was commonly prescribed at discharge by 64 per cent and 9 per cent of the respondents for castration and OVH respectively and up to 95 per cent for orthopaedic surgeries. This seems a very high proportion when compared with studies in other companion animals; 4 per cent of respondents prescribed analgesia postcastration in cats and 16 per cent and 24 per cent post-OVH in cats and dogs, respectively.^{15 18} A limitation of our study could be that approximately 50 per cent of the respondents worked in a veterinary clinic that treated ‘Only Exotics’ or a mix of species including exotics animals. It is therefore possible that a higher number of veterinary surgeons with an interest in rabbit and exotic animals were more likely to complete the online survey, and hence analgesia use may be overreported. Another limitation of this study is that the majority of the responses were from UK and this could potentially bias some of the results.

A novel aspect of this study is that it reports the length in days of the treatments prescribed at discharge, with the majority of the respondents prescribing postoperative analgesia for two to four days for those procedures considered less painful such as castration and OVH and between four and seven days for those more painful such as orthopaedic surgeries. Many papers in the literature report the drugs most commonly used to treat pain in companion animals without specifying how long the treatment was continued. In rabbits, the optimal duration of the analgesic treatment remains to be established, with only one paper suggesting that postoperatively, analgesia administration should be extended to up to seven days even for minimally invasive procedures.⁹

Conclusion

In conclusion, rabbit analgesia use has improved over recent years. Comparable to the trend seen in other companion animals such as cats and dogs, a higher percentage of veterinary surgeons prescribe analgesia than 10 and 20 years ago. Moreover, the use of multimodal analgesia is now common practice with the majority of veterinary surgeons prescribing a combination of NSAIDs and opioids even during routine procedures providing a more adequate pain relief in this species.

Overall, it seems that pain assessment is still limited in rabbits as well as in cats and dogs. However, the lack of multimodal composite pain scales specific for rabbits makes this task even more challenging in this species. This area needs indeed further improvement and further research is needed.

Twitter Emily Jayne Blackwell @dremilyb and Richard Saunders @Hutch_M_D

Acknowledgements The authors would like to thank The Alumni Association of the University of Bristol who supported this work.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Ethics approval This study was approved by the Faculty of Health Sciences Research Ethics Committee (FREC) of the University of Bristol.

Data availability statement No data are available. deidentified participant data. faculty research ethics committee ID 66205.

© British Veterinary Association 2020. No commercial re-use. See rights and permissions. Published by BMJ.

ORCID iDs

Livia Benato <http://orcid.org/0000-0003-2399-4194>

Joanna C Murrell <http://orcid.org/0000-0003-0456-5159>

References

- 1 PDSA, 2017. Available: https://www.pdsa.org.uk/media/3291/pdsa-paw-report-2017_printable-1.pdf
- 2 Katz J, Clarke H, Seltzer ZE'EV. Review article: preventive analgesia: quo vadimus? *Anesth Analg* 2011;113:1242–53.
- 3 Bonnet F, Marret E. Influence of anaesthetic and analgesic techniques on outcome after surgery. *Br J Anaesth* 2005;95:52–8.
- 4 Lascelles BD, Capner CA, Waterman-Pearson AE. Current British veterinary attitudes to perioperative analgesia for cats and small mammals. *Vet Rec* 1999;145:601–4.
- 5 Keown AJ, Farnworth MJ, Adams NJ. Attitudes towards perception and management of pain in rabbits and guinea pigs by a sample of veterinarians in New Zealand. *N Z Vet J* 2011;59:305–10.
- 6 Coulter CA, Flecknell PA, Leach MC, et al. Reported analgesic administration to rabbits undergoing experimental surgical procedures. *BMC Vet Res* 2011;7:6.
- 7 Keating SC, Thomas AA, Flecknell PA, et al. Evaluation of EMLA cream for preventing pain during tattooing of rabbits: changes in physiological, behavioural and facial expression responses. *PLoS One* 2012;7:11.
- 8 Benato L, Rooney N, Murrell J. Pain and analgesia in pet rabbits within the veterinary environment: a review. *Review* 2018.
- 9 Goldschlager GB, Gillespie VL, Palme R, et al. Effects of multimodal analgesia with LowDose buprenorphine and meloxicam on fecal glucocorticoid metabolites after surgery in New Zealand white rabbits (*Oryctolagus cuniculus*). *J Am Assoc Lab Anim Sci* 2013;52:571–6.
- 10 Hedenqvist P, Trbakovic A, Thor A, et al. Carprofen neither reduces postoperative facial expression scores in rabbits treated with buprenorphine nor alters long term bone formation after maxillary sinus grafting. *Res Vet Sci* 2016;107:123–31.
- 11 Hunt JR, Knowles TG, Lascelles BD, et al. Prescription of perioperative analgesics by UK small animal veterinary surgeons in 2013. *Vet Rec* 2015;176:493.
- 12 PDSA, 2011. Available: https://www.pdsa.org.uk/media/2584/pdsa_animal_wellbeing_report_2011.pdf
- 13 , Kohn DF, Martin TE, et al. ACLAM Task Force Members. Public statement: guidelines for the assessment and management of pain in rodents and rabbits. *J Am Assoc Lab Anim Sci* 2007;46:97–108.
- 14 Beswick A, Dewey C, Johnson R, et al. Survey of Ontario veterinarians' knowledge and attitudes on pain in dogs and cats in 2012. *Can Vet J* 2016;57:1274–80.
- 15 Weber GH, Morton JM, Keates H. Postoperative pain and perioperative analgesic administration in dogs: practices, attitudes and beliefs of Queensland veterinarians. *Aust Vet J* 2012;90:186–93.
- 16 Leach MC, Allweiler S, Richardson C, et al. Behavioural effects of ovariohysterectomy and oral administration of meloxicam in laboratory housed rabbits. *Res Vet Sci* 2009;87:336–47.
- 17 Weaver LA, Blaze CA, Linder DE, et al. A model for clinical evaluation of perioperative analgesia in rabbits (*Oryctolagus cuniculus*). *J Am Assoc Lab Anim Sci* 2010;49:845–51.
- 18 Farnworth MJ, Walker JK, Schweizer KA, et al. Potential behavioural indicators of post-operative pain in male laboratory rabbits following abdominal surgery. *Animal Welfare* 2011;20:225–37.
- 19 Weary DM, Niel L, Flower FC, et al. Identifying and preventing pain in animals. *Appl Anim Behav Sci* 2006;100:64–76.
- 20 Capner CA, Lascelles BD, Waterman-Pearson AE. Current British veterinary attitudes to perioperative analgesia for dogs. *Vet Rec* 1999;145:95–9.
- 21 Turner PV, Chen HC, Taylor WM. Pharmacokinetics of meloxicam in rabbits after single and repeat oral dosing. *Comp Med* 2006;56:63–7.
- 22 Fredholm DV, Carpenter JW, KuKanich B, et al. Pharmacokinetics of meloxicam in rabbits after oral administration of single and multiple doses. *Am J Vet Res* 2013;74:636–41.
- 23 Delk KW, Carpenter JW, KuKanich B, et al. Pharmacokinetics of meloxicam administered orally to rabbits (*Oryctolagus cuniculus*) for 29 days. *Am J Vet Res* 2014;75:195–9.

